

Challenges with Operating a Water Recovery System (WRS) in the Microgravity Environment of the International Space Station (ISS)

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Layne Carter was hired by NASA in 1988 after receiving a B.S. degree in Chemical Engineering from Oklahoma State University. He also received a M.S. degree in Environmental Engineering from the University of Alabama in Huntsville. During his 28 years at NASA, Mr. Carter has worked on the development, design, delivery and operation of the ISS Water Recovery System (WRS), which includes the Water Processor Assembly (WPA) and Urine Processor Assembly (UPA). His current role is the ISS Water Subsystem Manager, for which he is responsible for the ongoing operation of the water management and WRS on ISS. In addition, he is the co-Lead for NASA's Advanced Exploration Systems (AES) Wastewater Processing and Water Management team, which has the responsibility for developing the technologies to be used for NASA's future manned missions.

The ISS WRS produces potable water from crew urine, crew latent, and Sabatier product water. This system has been operational on ISS since November 2008, producing over 30,000 L of water during that time. The WRS includes a Urine Processor Assembly (UPA) to produce a distillate from the crew urine. This distillate is combined with the crew latent and Sabatier product water and further processed by the Water Processor Assembly (WPA) to the potable water. The UPA and WPA use technologies commonly used on ISS for water purification, including filtration, distillation, adsorption, ion exchange, and catalytic oxidation. The primary challenge with the design and operation of the WRS has been with implementing these technologies in microgravity. The absence of gravity has created unique issues that impact the constituency of the waste streams, alter two-phase fluid dynamics, and increases the impact of particulates on system performance. NASA personnel continue to pursue upgrades to the existing design to improve reliability while also addressing their viability for missions beyond ISS.